

## Production of Electrolysis-Purity Water, Phase I

Completed Technology Project (2010 - 2010)



## Project Introduction

Removal of impurities from water has been studied extensively by NASA in the context of water recovery from wastewater. However, the Water Recovery System and Urine Processor Assembly currently used in the International Space Station can only recover as much as 90% of the water (Carter, 2009). Complete dewatering is not possible for these technologies since they are not designed for handling solids and processing is stopped before precipitates form. The only water recovery process that can handle solids is the Air Evaporation System (AES) which uses porous rayon wicks but its performance is severely limited by its low thermal conductivity and susceptibility to microbial growth. We propose to improve on the AES by designing an evaporation system using thermally conductive porous media. The high surface area and porosity of these porous media coupled with the use of vapor-compression distillation results in a novel system that can recover almost 100% of the water at the desired purity with high energy efficiency and minimal consumables. Makel Engineering and Cornell University are proposing the use of two processes, (1) freeze-concentration and (2) porous media evaporation, to produce water that meets electrolysis purity requirements needed for oxygen production from lunar regolith. While freeze-concentration systems have been shown to be effective in purifying water for terrestrial applications, we believe that our proposed process is the first to power the freezing-melting cycle by a thermoelectric heat pump. Our innovative system will exploit the property of thermoelectrics to reverse their heating and cooling sides, leading to the reuse of the enthalpy of fusion and simple equipment design. In principle, our process will operate at high energy efficiency, recover more than 99% of the water from the feed at the desired purity, and use no consumables.



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## Table of Contents

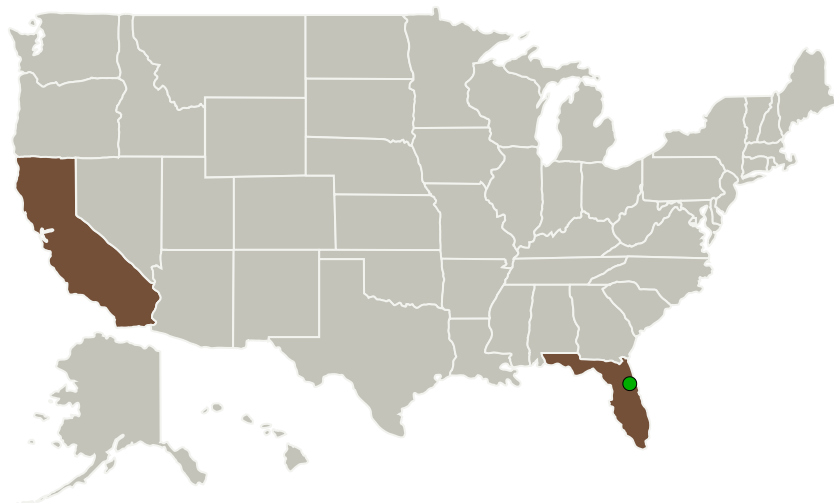
|  |   |
|--|---|
| Project Introduction                         | 1 |
| Primary U.S. Work Locations and Key Partners | 2 |
| Project Transitions                          | 2 |
| Organizational Responsibility                | 2 |
| Project Management                           | 2 |
| Technology Maturity (TRL)                    | 2 |
| Technology Areas                             | 3 |
| Target Destinations                          | 3 |

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## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role                    | Type  | Location                      |
|-------------------------------|-------------------------|---|-------------------------------|
| Makel Engineering, Inc.       | Lead Organization       | Industry Small Disadvantaged Business (SDB) | Chico, California             |
| ● Kennedy Space Center(KSC)   | Supporting Organization | NASA Center                                 | Kennedy Space Center, Florida |

## Primary U.S. Work Locations

|            |         |
|------------|---------|
| California | Florida |
|------------|---------|

## Project Transitions

▶ **January 2010:** Project Start

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Makel Engineering, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

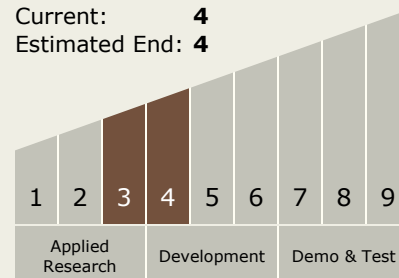
Susana Carranza

## Technology Maturity (TRL)

Start: 3

Current: 4

Estimated End: 4



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**July 2010:** Closed out

**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/139351>)

### Technology Areas

**Primary:**

- TX07 Exploration Destination Systems
  - └ TX07.1 In-Situ Resource Utilization
    - └ TX07.1.3 Resource Processing for Production of Mission Consumables

### Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System